Radio's Role in Aeronautics

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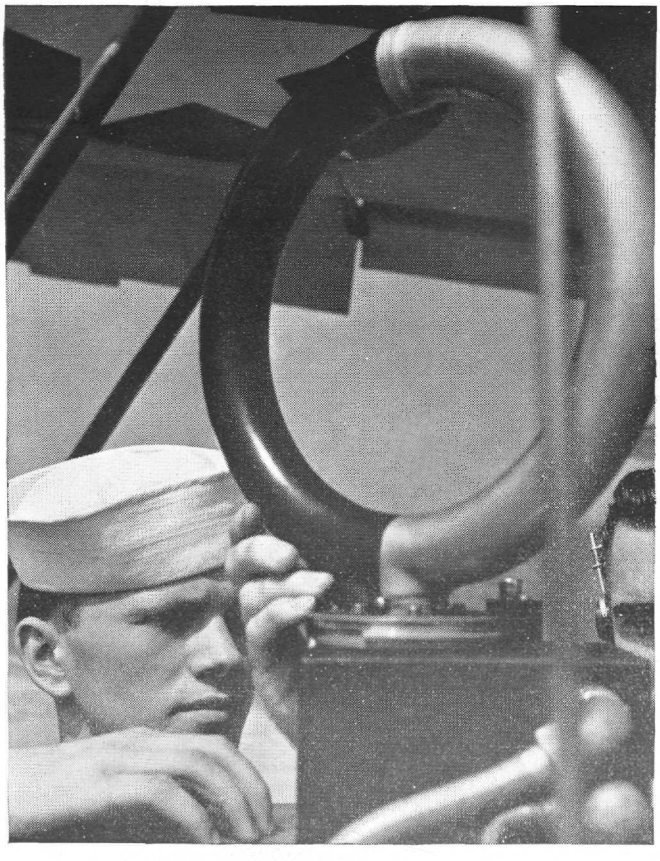
The airplane is the most rapid means of transportation made available to man up to the present time, and it requires for its maintenance and operation a system equally as rapid. If such a system could not be had, the science of aviation would progress slowly indeed.

It is the duty of the radio engineer to see that ships in the air get valuable information on such vital data as weather and mountain flying conditions. It is he who is responsible for keeping airplanes on their course in boundless space, and for assisting in their landings and departures. Also, he is credited with having saved countless lives in forced and emergency landings.

In designing radio equipment for airplane installation, a number of factors must be taken into consideration. The apparatus must be light, so as not to decrease the efficiency of the craft, and it must be sturdy, to withstand the constant heavy vibration always encountered in airplanes. The receiver and its antenna must be extremely sensitive in order to be able to pick up weak signals. The receiver itself must have a high output to overcome such mechanical plane noises as rushing wind or motor noise. The ignition system, a source of very heavy interference, must be completely shielded. Briefly, then, reliability and simplicity are the prime requirements.



● Using a loop antenna for direction finding by discovering the null point.

Courtesy Radio News—Feb.

At the airports are located the various radio beams, beacons, and markers which are necessary to keep planes on their courses. The introduction of these instruments brought on complicated problems in frequency range and signal coverage. All airports were located about 200 miles apart, so it was necessary to employ a transmitter and antenna system which would operate over a distance of 100 miles to insure constant contact between pilot and ground. Various frequencies were tested to find one suitable to fulfill satisfactorily that requirement. Frequencies between 550 kc and 1500 kc were excellent but were not available, since they were already used for commercial broadcast purposes. The International Radio Telegraph Convention allocated the band 315 kc to 350 kc for mobile use, but those frequencies were found unsatisfactory because of the very long antenna required. The Convention also reserved 1500 kc to 6000 kc for aircraft work, and that was the band which received the most attention. Spots in that band can be found to satisfy any domestic communication requirement. The lower section of the band is best suited for trailing antennas, while on the higher frequencies fixed antennas of small size are found to operate well.

The band between 4000 kc and 6000 kc lends itself better to use in the daytime, since it offers greater resistance to the usual daytime static interference and height of the ionosphere. However, the 1500 kc—3500 kc band has been found best for communication at night because it stabilizes signals which would otherwise be uncontrollable at that time.

Among the many instruments employed in aeronautics which utilize some principles of radio in their operation are the direction finders, radio beacons, radio markers, and radio altimeters.

The direction finder, in its simplest form, consists of a receiver connected to a loop of wire instead of the regular antenna. This "loop antenna" has definite directional characteristics. When a signal is being received, the loop should be turned until the signal is strongest. The plane of the

loop will then be in line with the source of the signal—the airport. In actual practice, a meter is connected to the receiver so that its needle will be vertical at the strongest signal position, and go to the left or right as the signal weakens.

Radio beacons are those signals which enable a pilot to hold his course in almost any type of condition and arrive safely at his destination. The beacon signals are transmitted in the 285 kc to 315 kc band, while weather information is sent on frequencies between 315 kc and 350 kc. A system which is becoming increasingly popular is one by which both the weather and beacon signals can be alternately transmitted on the same frequency, in order that the pilot need not retune his receiver.

The beacon in almost universal use is the "N and A" beacon. Two long loop antennas are arranged at right angles at the airport. The letter "N" in Morse code (—.) is fed to one antenna simultaneously with "A" (.—) to the other antenna. When a pilot approaches either antenna broadside, he will hear "N" or "A" in his receiver, depending on the direction from which he approaches. However, if he approaches the airport along one of the lines which bisect the angle between the antenna axes, the two Morse characters will exactly overlap, and he will hear a continuous signal.

The two antennas can be orientated so that the continuous tone lines fall along the routes to the airport. If the pilot veers off to one side or the other of his course, he will no longer hear the continuous signal, but either "A" or "N," depending on the direction of his error. This type of beam is effective over only 30 miles, but is simple and inexpensive.

The remaining two instruments, the radio marker and the radio altimeter, are of too technical a nature to be treated adequately here.

Radio markers are used to mark a pilot's course and to enable him to adjust his position with respect to the ground over which he is flying. They are of two types. One, giving only a general check, is operated on the same frequency as the range beacon mentioned above. The other, providing a much more accurate position check, utilizes the ultra-high frequency of 75 megacycles.

The radio altimeter was devised to replace the inefficient mechanical altimeter which indicated height above sea level only, and was useless in mountainous areas. The radio altimeter operates on the same principle as the depth sounders used aboard ocean vessels, in that the distance to the ground is measured by the time necessary for a radio signal to reach the ground and be reflected back to the plane. This meter is effective only under 5000 feet.

• **Machining plastic aircraft antenna housings.**
Courtesy General Electric

For general communication between airplane and air port, frequencies of 3105 kc or 6210 kc are used. After the pilot informs the radio control tower that he is ready to depart, the tower gives him information on wind conditions, and assigns him to an appropriate runway. When the pilot taxis into position, the tower again checks wind direction and velocity, and makes sure that no aircraft are approaching for a landing. The pilot then gets the "all clear" signal.

Planes approaching the airport call the radio tower when they are about ten minutes away and give the estimated time of arrival, the altitude, and the ship's position. In return, the tower reports on wind conditions and barometer, and position and altitude of planes in the vicinity. Between the time of taking off and landing, the radio beacons and markers are used almost entirely.

In a highly technical field such as this, men with thorough, specialized training are necessary. To become rated as proficient and given the responsible job of directing aircraft, the aeronautical radio operator must learn: weather observation, aircraft radio-telephone contact procedure, deciphering teletyped weather sequences and in-

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the end of the present world war, aeronautical radio shall have acquired enough inertia to bring it into a prominence which will be unrivaled.

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formation, CAA flight plan operations, CAA flight regulations, how beam flying is accomplished, and the general conditions affecting flights within his allocated territory.

Both radio and aeronautics are relatively new endeavors. They have just begun to develop. At